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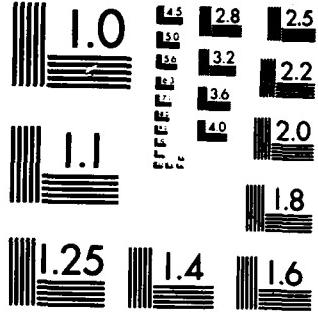
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HIGH CURRENT BETATRON STABILITY AND INJECTION STUDIES

T. P. Hughes
B. B. Godfrey
M. M. Campbell

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Prepared by:

MISSION RESEARCH CORPORATION
1720 Randolph Road, S.E.
Albuquerque, New Mexico 87106

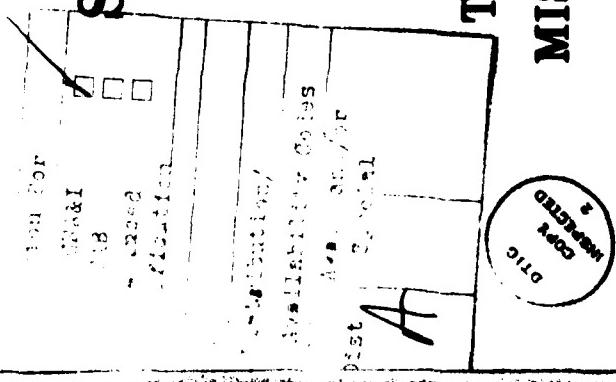
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HIGH CURRENT BETATRON
STABILITY AND INJECTION STUDIES



T. P. HUGHES, B. B. GODFREY, M. M. CAMPBELL
MISSION RESEARCH CORPORATION, ALBUQUERQUE

AMRC-VG-0343-1

✓ MRC CONTRIBUTING IN SEVERAL AREAS OF HIGH CURRENT
CYCLIC INDUCTION ACCELERATOR RESEARCH:

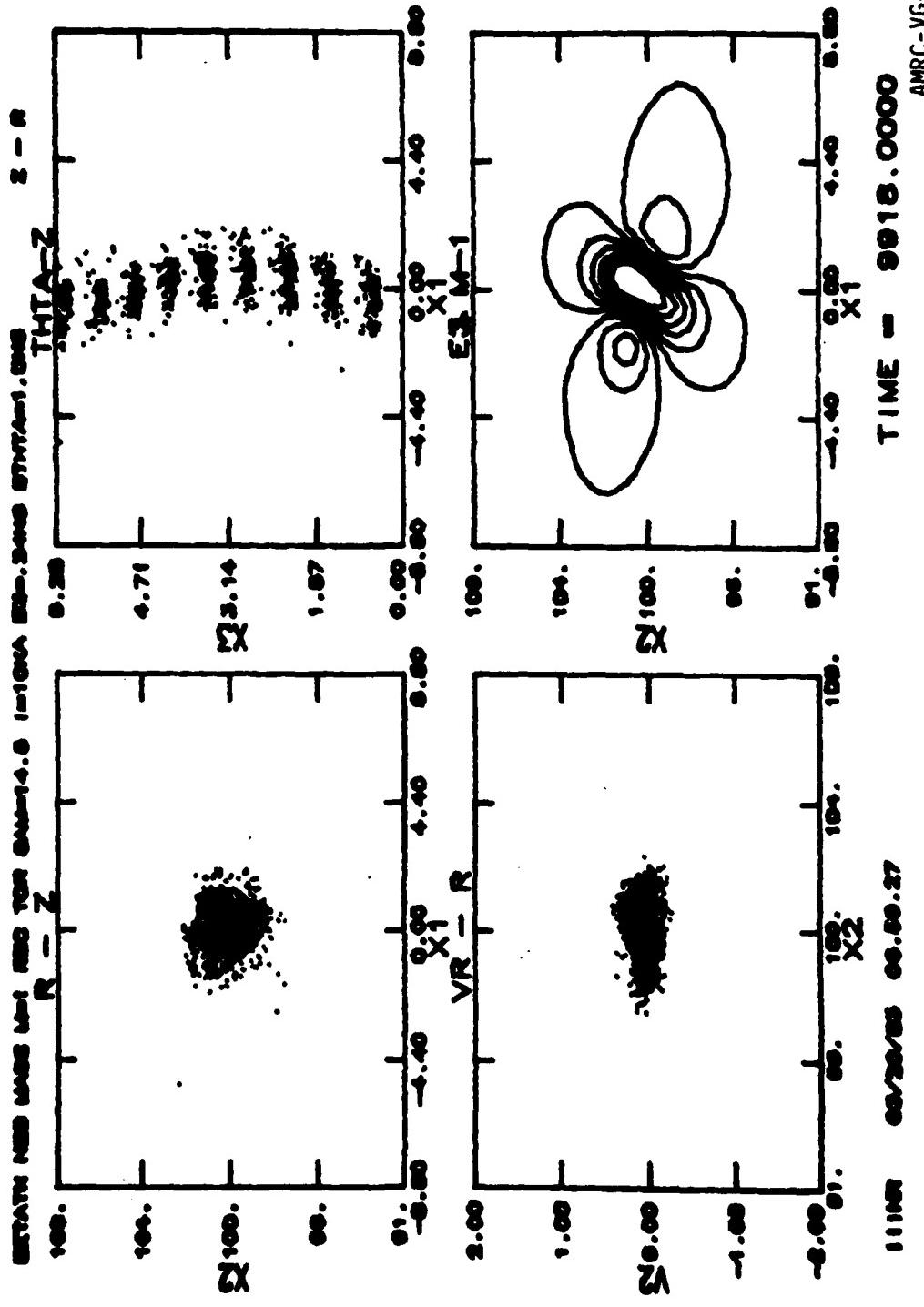
- (1) ➡ LINEAR THEORY OF NEGATIVE MASS AND RESISTIVE WALL INSTABILITIES IN MODIFIED BETATRON,
- (2) ➡ LINEAR THEORY OF BEAM BREAKUP INSTABILITY IN RECIRCULATING INDUCTION ACCELERATOR,
- (3) ➡ SINGLE-TURN INJECTION SIMULATION FOR MODIFIED BETATRON,
- (4) ➡ MULTI-TURN INJECTION SIMULATION FOR CONVENTIONAL BETATRON, α_{us} ,
- (5) ➡ NEGATIVE MASS INSTABILITY SATURATION SIMULATION.

PRESENTATION REVIEWS NEGATIVE MASS SATURATION, NEGATIVE MASS LINEAR THEORY, MULTI-TURN INJECTION.

**PRELIMINARY SIMULATIONS OF NEGATIVE MASS INSTABILITY
SHOW BEAM DISRUPTION IN SOME CASES, NOT IN OTHERS**

- SIMULATIONS PERFORMED WITH WELL TESTED 3-D PIC CODE "IVORY"
- CALCULATIONS DONE IN TOROIDAL DRIFTTUBE WITH RECTANGULAR MINOR CROSSSECTION
- BEAM INITIALIZED FROM FINN-MANHEIMER EQUILIBRIUM CODE WHEN APPROPRIATE
- SATURATION BY PARTICLE TRAPPING (SEVERE LOSSES)
FOR LAMINAR BEAM BELOW PARAMAGNETIC TRANSITION
- APPARENT SATURATION BY BEAM HEATING (SMALL LOSSES)
FOR WARM BEAM ABOVE PARAMAGNETIC TRANSITION

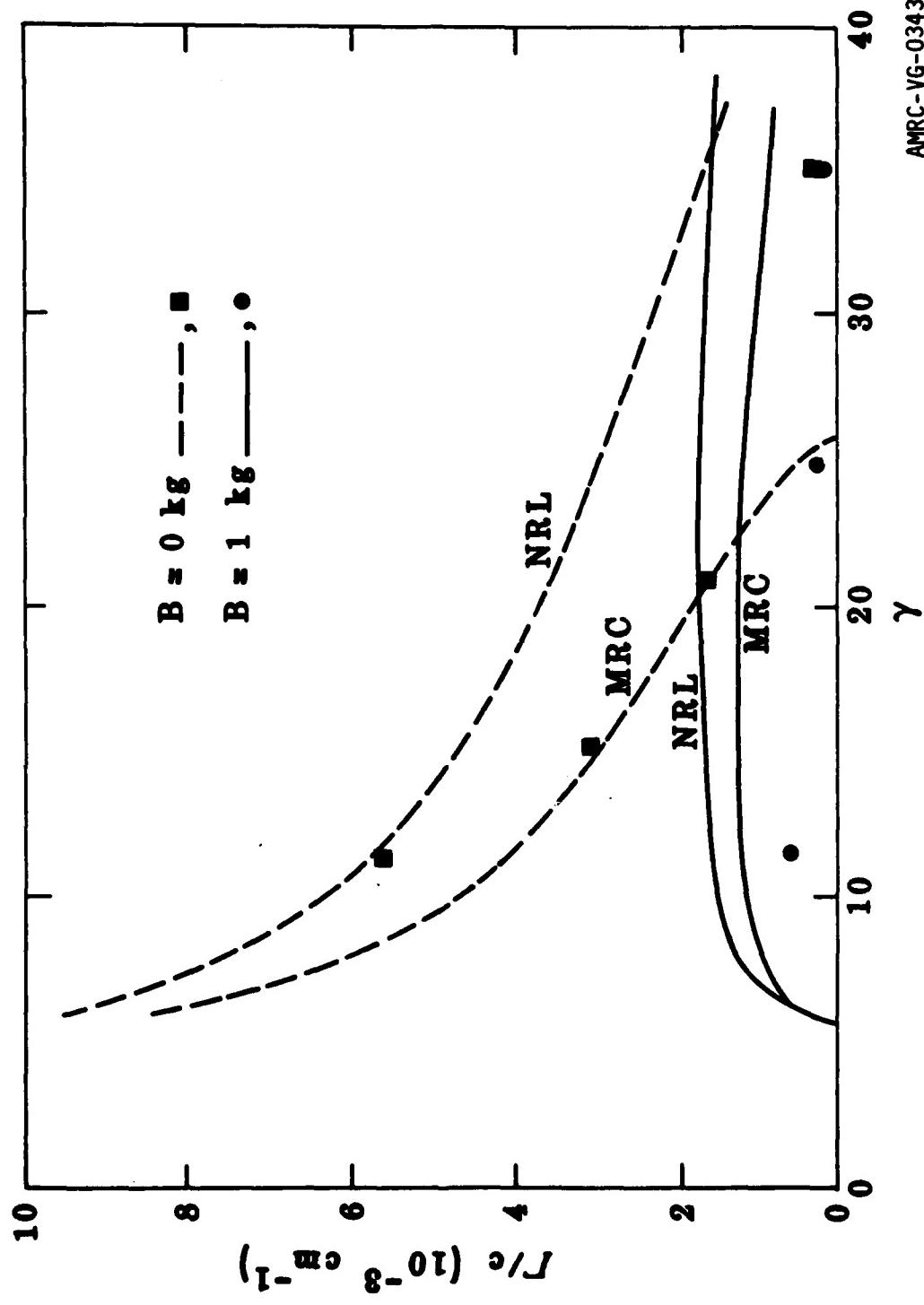
TYPICAL MOVIE FRAME DEPICTING LINEAR STAGE OF
NEGATIVE MASS INSTABILITY IN 10kA, 7 MeV BEAM



MORE WORK NEEDED ON NEGATIVE MASS INSTABILITY LINEAR
GROWTH RATES TO AID SIMULATIONS, EXPERIMENTS.

- EXISTING MODELS TREAT BEAM AS STRING OF RIGID DISKS IN TOROIDAL GEOMETRY
- ELECTROMAGNETIC FIELDS OF INSTABILITY COMPUTED IN CYLINDRICAL GEOMETRY
- NRL, MRC GROWTH RATES TYPICALLY DIFFER BY ABOUT 50%
- RIGID DISK SIMULATIONS WITH IVORY SHOW SLOWER GROWTH THAN EITHER MODEL
- ANALYTICAL MODELS PROBABLY ERR IN IGNORING TOROIDAL FIELD CORRECTIONS

SIMULATIONS, ANALYTICAL MODELS GIVE DIFFERENT
NEGATIVE MASS INSTABILITY GROWTH RATES



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MULTI-TURN INJECTION SIMULATION SHOWS GOOD
TRAPPING OF 5kA, 40 MeV BEAM.

- TOROIDAL MAGNETIC FIELD NOT NEEDED FOR
EQUILIBRIUM OF HIGH ENERGY BEAM
 - CURRENT SUPPLIED BY HYPOTHETICAL 125 A,
40 MeV RF LINAC DURING 40 REVOLUTIONS
 - BEAMLETS TRAPPED BY ADIABATIC DEPRESSION
OF ELECTROSTATIC POTENTIAL, FORM ANNULAR
BEAM
 - NEGATIVE MASS, DIOCOTRON INSTABILITIES NOT
YET INVESTIGATED
- MULTI-TURN INJECTION STUDY DONE IN COLLABORATION
WITH WESTERN RESEARCH CORPORATION.

**RESEARCH PLANS PUT HEAVY EMPHASIS ON NEGATIVE
MASS INSTABILITY.**

- IMPROVED LINEAR STABILITY ANALYSIS
- IVORY SIMULATIONS OF INSTABILITY SATURATION
FOR WARM BEAMS AT VARIOUS ENERGIES
- BEAM BEHAVIOR DURING PARAMAGNETIC TRANSITION
- COMPUTATIONAL ASSISTANCE FOR NRL, U.C. IRVINE
BETATRON EXPERIMENTS
- COUPLING BETWEEN NEGATIVE MASS, KLYSTRON
MODES
- STABILITY OF MULTI-TURN INJECTION

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EQUILIBRIUM CODE
- IVORY DEVELOPED WITH SUPPORT FROM LOS ALAMOS
NATIONAL LABORATORY

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